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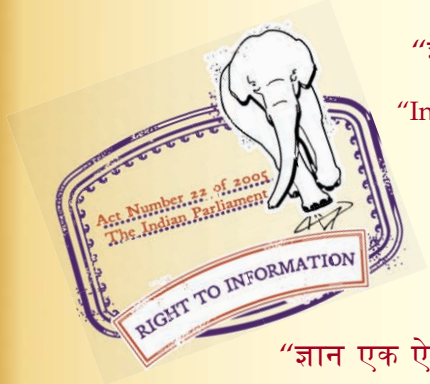

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Indian Standard

TEXTILES — DETERMINATION OF WATER ABSORPTION AND PENETRATION OF FABRICS USING BUNDESMANN TYPE APPARATUS

(Third Revision)

भारतीय मानक

वस्त्रादि — बुण्डसमान टाइप उपकरण का प्रयोग करके वस्त्रों में जल अवशोषण और जल भेद्यता ज्ञात करना

(तीसरा पुनरीक्षण)

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FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards on 15 May 1989, after the draft finalized by the Chemical Methods of Test Sectional Committee had been approved by the Textile Division Council.

This standard, first published in 1952, was revised in 1962 and 1975. It has been again revised keeping in view the experience gained during its use and to make it up-to-date according to the national and international practices followed in this field. In this revision, modifications have been carriep out in scope, preparation of test specimens, procedure, and description of the test apparatus.

The work carried out with the Bundesmann apparatus has produced evidence of unidentifi variables. The reproducibility of the method is such that although variability within tests or ed given apparatus may be reduced to a satisfactory level, the variability between tests on differenta apparatus may be large. However, for testing water-repellency and water resistance of textile fabrics, the use of the Bundesmann apparatus is well established since the method fulfils a need where quality control testing within a laboratory is concerned.

Water passes through water-resistant fabrics by:

a) wetting of one side of the fabrics followed by capillary action thus bringing the water to the other side and wetting it (the resistance offered by fabrics to this action is influenced mainly by their water-repellency),

b) penetration of water through their interstices under its own or applied pressure (the resistance offered by fabrics to this action is influenced mainly by their construction or structure), or

c) a combination of (a) and (b).

A number of test methods have been developed for testing waterproofness, water repellency and water resistance of fabrics, namely, spray test, hydrostatic head test, Bundesmann test and cone test. However, the use of a particular test depends upon the type of fabric under test and its end use. So far no correlation has been established between the results of different test methods and hence their results are not comparable. The Bundesmann test adopted in this standard is designed to assess the behaviour of water resistant fabrics when exposed to heavy rain.

To assess the efficiency of proofing of water resistant fabrics permeable to air, the quantity of water absorbed by the specimen and that forced through the specimen as a result of exposure to artificial rainfall for the period of test are measured separately, and the data considered collectively.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

TEXTILES — DETERMINATION OF WATER ABSORPTION AND PENETRATION OF FABRICS USING BUNDESMANN TYPE APPARATUS

(Third Revision)

1 SCOPE

1.1 This standard prescribes a method for determination of water repellency, resistance to wetting (in term of water absorbed) and resistance to penetration by water (in terms of water penetrated) of fabrics by the Bundesmann type apparatus.

1.1.1 It is primarily applicable to woven or non-woven water repellent fabrics that are permeable to air.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
IS 3919 : 1966	Methods for sampling cotton fabrics for determination of physical characteristics
IS 6359 : 1971	Method for conditioning of textiles

3 PRINCIPLE

3.1 Four specimens of the fabrics under test are simultaneously exposed to a simulated heavy rain shower of controlled intensity, while the specimen as a whole is flexed and the undersurface subjected to the rubbing action. The water absorbed by the specimens is determined after the test is over which is the measure for resistance to wetting. The penetrated water collected in cups is the measure for resistance to penetration by water.

4 SAMPLING

4.1 Sample shall be drawn so as to be representative of the lot. Sample drawn in compliance with the procedure laid down in the material specification or as agreed to between the buyer and the seller shall be taken as representative of the lot. In case of cotton fabrics, reference to IS 3919 : 1966 shall be made.

5 PREPARATION OF TEST SPECIMENS

5.1 Condition the test sample as specified in **6.1**. From each individual piece in the test sample, cut out four circular test specimens without any crease, each of 140 mm diameter with a circular dye such that each is taken from different location spaced at least 100 mm away from the edge of the fabric sample being tested. The specimens shall not be folded, ironed or treated otherwise during the interval between the drawing of the sample and testing, except for conditioning. If possible the specimens should not be taken directly from the ends of the material, since experience has shown that the area density (for example, structure) and the finishing may be different to that of the majority of the fabric.

NOTE — The cutting of specimens by means of a circular cutting die and press is facilitated if squares 150 mm × 150 mm are first cut from the fabric sample.

6 CONDITIONING AND TESTING ATMOSPHERE

6.1 The test specimens shall be conditioned in the standard atmosphere at 65 ± 2 percent relative humidity and 27 ± 2°C temperature at least for 24 hours (*see* IS 6359 : 1971). In case of fabric specimens heavier than 270 g/m², the minimum conditioning period shall be 48 hours.

6.2 The tests shall be preferably carried out in standard atmosphere (*see* **6.1**). In case it is not possible to carry out the test in standard atmosphere, the specimens shall be conditioned as provided for in **6.1** and tested in prevailing atmosphere within 15 minutes of their removal from the standard atmosphere (*see* **6.1**).

7 APPARATUS

7.1 The apparatus shall be of the continuous-shower type (*see* Annex A for details).

7.2 Suitable Means for Cutting Specimens of 140 mm Diameter

A circular die shall be used with a press or a template and scissors.

7.3 A Mechanical Shaker, conforming to requirements given in **A-5**.

7.4 A Stop-Watch or Stop Clock

7.5 Airtight Containers

These containers shall be of known mass and of such a shape and size that the specimen may be inserted without being creased before exposure to the shower.

7.6 A Balance, sensitive to 0·01 g.

8 PROCEDURE

8.1 Determine the mass of each conditioned specimen in a tared airtight container to the nearest 0·01 g. Set the shower working. The water supply used for the test shall conform to the following requirements and any blocking to the drop-forming system (by foreign matter, etc) must be avoided. Use of a filter (containing porcelain, Kieselghur candles) on water feeding is recommended.

a) *Temperature*

The temperature of water in the shower tank shall be 27 ± 2°C. A thermostatically controlled domestic electric water heater may be used to maintain the required temperature.

b) *p*H

The *p*H of the water shall be 7·0 ± 1·0.

NOTE — If required, *p*H may be adjusted by passage of water through suitable ion-exchange resins, or distilled water may be used.

c) *Rate of Flow*

The rate of flow of water into a cup shall be 65 ± 3 ml/min per cup.

8.1.1 Check the rate of flow at least once every 60 min of continuous operation as follows:

Place the cup assembly in position inside the apparatus, with the cups drained and the draincocks closed. Switch on the motor. Swing away the tray to allow the drops to fall on the cups, simultaneously starting the stop watch or stop clock. Expose the cups for 1 min, swing the tray into position to intercept the shower, stop the motor and remove the cup assembly to its stand. Dry the outside of the draincocks. Drain each cup through the draincock into a 100 ml graduated cylinder and check that the required rate of flow has been obtained.

8.2 Before mounting the test specimens, dry all parts of the cups, wipers and clamps that may come in contact with the specimens. Remove any water in the exit tubes. Do not dry the insides of the cups which should be in drained condition at the start of each test. Close the draincocks.

8.3 Mount the specimens with the wiper mechanism in the depressed position. Lay the specimens over the cups and apply the size of clamping ring that will expose an area of specimen with diameter as close as possible to 100 mm. The specimens must be in continuous contact with the rims of cups without folds or other irregularity. Lock the clamping rings in position with the spring-operated clamps.

NOTE — It is important to note that the clamps should be so designed that according to its thickness, the test specimen is not exposed where it is mounted over a hard backing (for example, the outside of the cup rim) since the impact of the shower on fabric so mounted may lead to an increase in penetration through the test specimen.

8.4 Release the wiper arms, if necessary and place the cup assembly in position inside the apparatus. Switch on the motor. Swing away the tray to allow drops to fall on the specimens, simultaneously starting the stop-watch or stop-clock. Expose the specimens to the shower for 10 min unless otherwise agreed between the buyer and the seller.

8.5 At the end of the test period, swing the tray into position to intercept the shower, stop the motor and remove the cup assembly to its stand. Immediately unclamp each specimen from the cups and remove the loosely attached water by gripping each specimen without folding or creasing it in the clip of the mechanical shaker and rotating the handle so that the specimen receives 10 shakes. Transfer each specimen to an airtight container immediately after the shaking is completed.

8.6 Determine the mass of each loaded container to the nearest 0·01 g.

8.7 Dry the outside of the closed draincocks. Individually drain each cup into a measuring cylinder and measure to the nearest millilitre the volume of water collected from each cup separately.

8.8 Expression of Results

Calculate the absorption and penetration of water as follows.

8.8.1 *Absorption*

Calculate the percentage of absorption of water by the following formula:

$$A = \frac{(M_2 - M_1) \times 100 \times 2}{M_1}$$

where

A = percentage of absorption of water,

M_1 = mass of the test specimen before test in g, and

M_2 = mass of the test specimen after testing in g.

NOTE — Since the total area of the test specimen is double the exposed area, it is necessary to multiply the absorption figure by two to get the correct results.

8.8.2 *Penetration*

The volume of water in millilitres, collected in each cup, shall be expressed as the penetration of water.

8.8.3 The average of the four test results for absorption and penetration shall be deemed to be : (a) absorption in percentage, and (b) penetration in millilitre of water by and through the specimen, respectively.

8.9 Repeat the test prescribed in **8.1** to **8.8.3** with the remaining pieces in the test sample.

9 REPORT

9.1 The report shall include the following information:

a) The nature of the textile fabric tested;

b) The temperature, hardness and *p*H value of water used;

c) The period of rain shower exposure to;

d) The number of tests performed;

e) The absorption of water in percent by mass of each test specimen in the sample, the arithmetic mean and range; and

f) The penetration of water (in ml) through each test specimen.

ANNEX A

(*Clause* 7.1)

BUNDESMANN TYPE APPARATUS

A-1 GENERAL DESCRIPTION

A-1.1 The Bundesmann apparatus (*see* Fig. 1) shall be provided with a water tank fitted with a number of fine jets to generate a shower of water simulating rainfall. The tank shall be mounted on a fixed height above the four metal test cups provided for mounting the specimens. The cups shall be mounted on the apparatus in such a manner that they can be rotated by means of an electric motor ensuring equal exposure for each specimen to falling water. The interior of each cup (or specimen holder) shall be fitted with an automatically worked wiper device. The wiper arms shall press lightly against the specimen by means of springs so that the specimen is flexed slightly in addition to the rubbing action as the wiper arms pass over its surface. The cups and base plate shall be separated from the electric motor by means of a sheet metal trough.

A-2 SHOWER

A-2.1 The shower tanks shall be provided with 304 brass jets made as shown in Fig. 2. They shall be placed 20 mm apart centre-to-centre.

A-2.2 The means shall be provided for the formation of uniformly spaced drops of average mass 0·075 ± 0·010 g when the rate of flow of water at 27 ± 2°C and *p*H 6 to 8 is established at 65 ± 3 ml/min per cup.

A-2.3 The drops shall fall vertically and cover an area greater than that swept by the cups as the cups assembly rotates. The vertical distance between the centre of the specimens when fixed in a position at which the drops are released, shall be 1 500 ± 10 mm.

A-3 CUP ASSEMBLY

A-3.1 The cup assembly shall rotate at 5 ± 1 rev/min under the shower.

A-3.2 Four cups shall be so mounted on the assembly that the specimens are tilted 10 to 15° to the horizontal so as to shed water outwards. The centre of the mounted specimens shall be 105 ± 10 mm from the vertical axis of rotation of the cup assembly.

A-3.3 The cups having a circular orifice shall be provided with clamps of such a kind that an area of the specimen with 100 mm diameter is exposed. There shall be no leakage round the mounted specimen into the cup and through the specimen at the clamps.

A-3.4 An exit hole or aperture of 7 ± 1 mm diameter shall be provided for allowing air displacement but not permitting the ingress of water into the cup. The cups shall have a minimum capacity of 350 ml when water fills the cup up to the exit hole. The cup shall be provided with draincocks; having a bore of 3 mm, *Min* so that the water collected may be completely drained.

NOTE — The air exit holes in the cups may be advantageously provided with external metal tubes that are bent in such a way that the impact of the shower on the cup assembly does not cause the water to splash up into the tubes during the test period. This will prevent water that overflows down the cup during the exposure from becoming lodged in the exit hole.

A-3.5 Each cup shall be provided with four wiper arms fixed at right angles to each other and rotating about the axis of the cup. When released, the highest point of the wiper arm shall stand 3·0 mm proud of the rim of the cup and the wipers shall press initially against the specimen with a load of 400 ± 50 g. The wiper arms shall sweep an arc of 100 ± 5°, making 20 complete oscillations per minute. The length of the base of the wiper arms shall be 96 mm. the maximum width of the wiper and its support shall not exceed 9·5 mm. The horizontal locating surfaces of the wiper supports shall lie in the same plane and this plane shall be at right angles to the axis of rotation of the wiper-head spindle.

A-3.6 The wiping surfaces shall be made from stainless steel of good quality. The operative surface of the wipers shall be formed by machining the material to form a part of the cylinder having a diameter 12·7 ± 0·1 mm with its axis disposed radially about the wiper head spindle when viewed from above and tilted downwards 2° ± 3′ when viewed horizontally. The thickness of the wiping surface shall be from 5·08 to 5·13 mm. The extremities of the wipers shall

have a radius of 3 mm. The centre of the wipers shall be indented in the form of a cone with a diameter of 13 mm diminishing to 11 mm over a depth of 0·8 mm so that the centre of indentation is coaxial with the wiper head spindle and at the intersection of the axis of the wiper cylinders. Care shall be taken to ensure that the ends of the single wiper make a closely fitting but joint with the opposite sides of the doubled wiper. The machining marks shall then be carefully removed by filling parallel to the cylinder axis and final polish given to the surface by Grade 00 emery paper to which is added a little paraffin. Paraffin residues which would contaminate the next specimen to be tested, should be removed by subsequent cleaning, such as, with trichloroethylene.

A-4 FILTER

A-4.1 It is desirable for almost all water supplies, to provide a filter to obviate the need for frequent cleaning of jets. A piece of closely woven cotton fabric, wrapped around a perforated metal support, may be efficient filter for use on Bundesmann type apparatus.

A-5 MECHANICAL SHAKER

A-5.1 A clip for holding the specimen shall be attached at the end of 213 mm long arm to which a torque of 9·7 kgf cm should be applied when this arm is released. The arm shall move through an arc of 170° to the horizontal position and come to rest with a residual torque of 1·15 kgf cm.

A-5.2 The mass of the arm shall be such that the velocity measured tangentially at a radius of 195 mm and at a deflection of 140 $\pm$ 5° from the initial position shall be 5.4 $\pm$ 0·54 m/s.

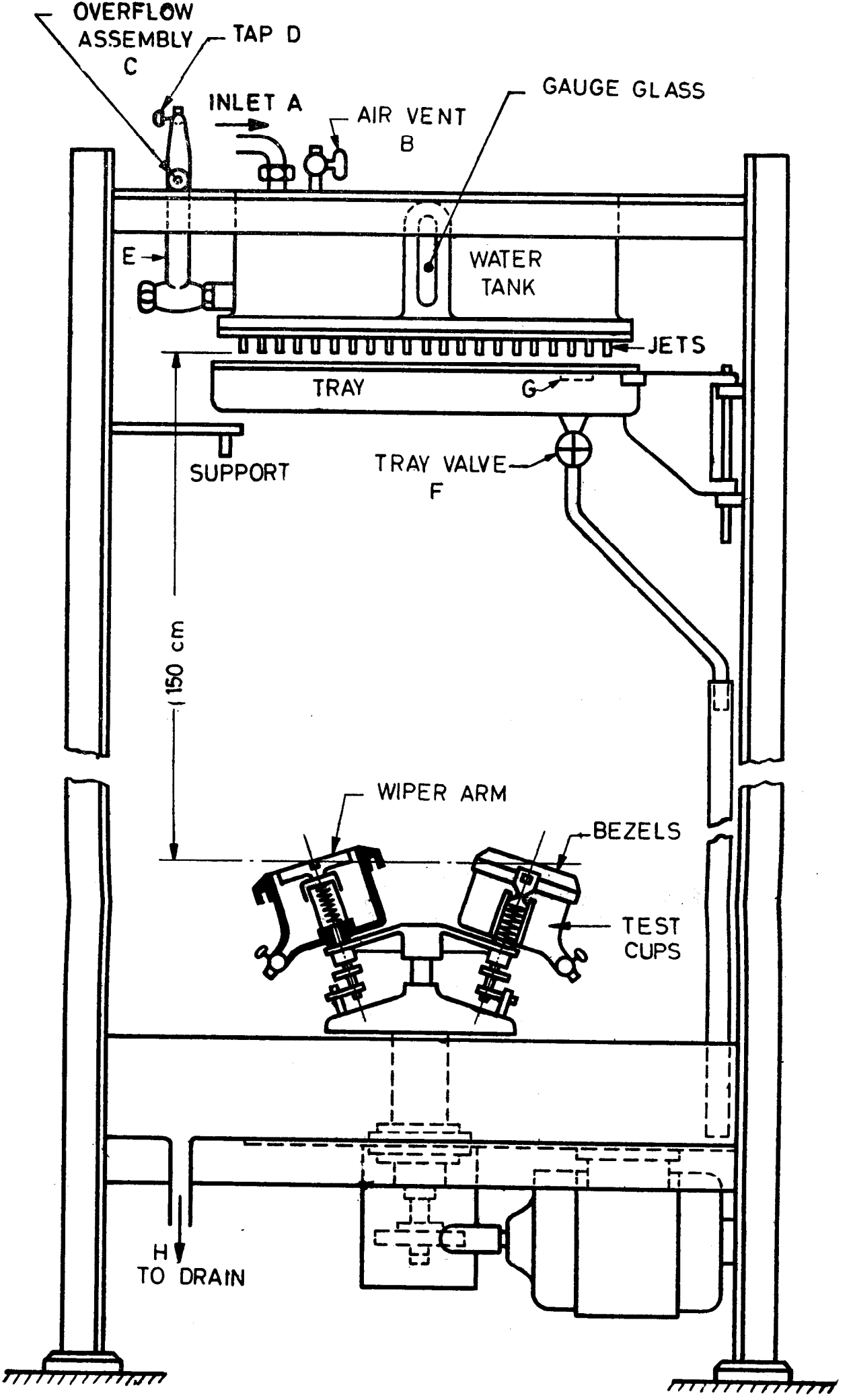
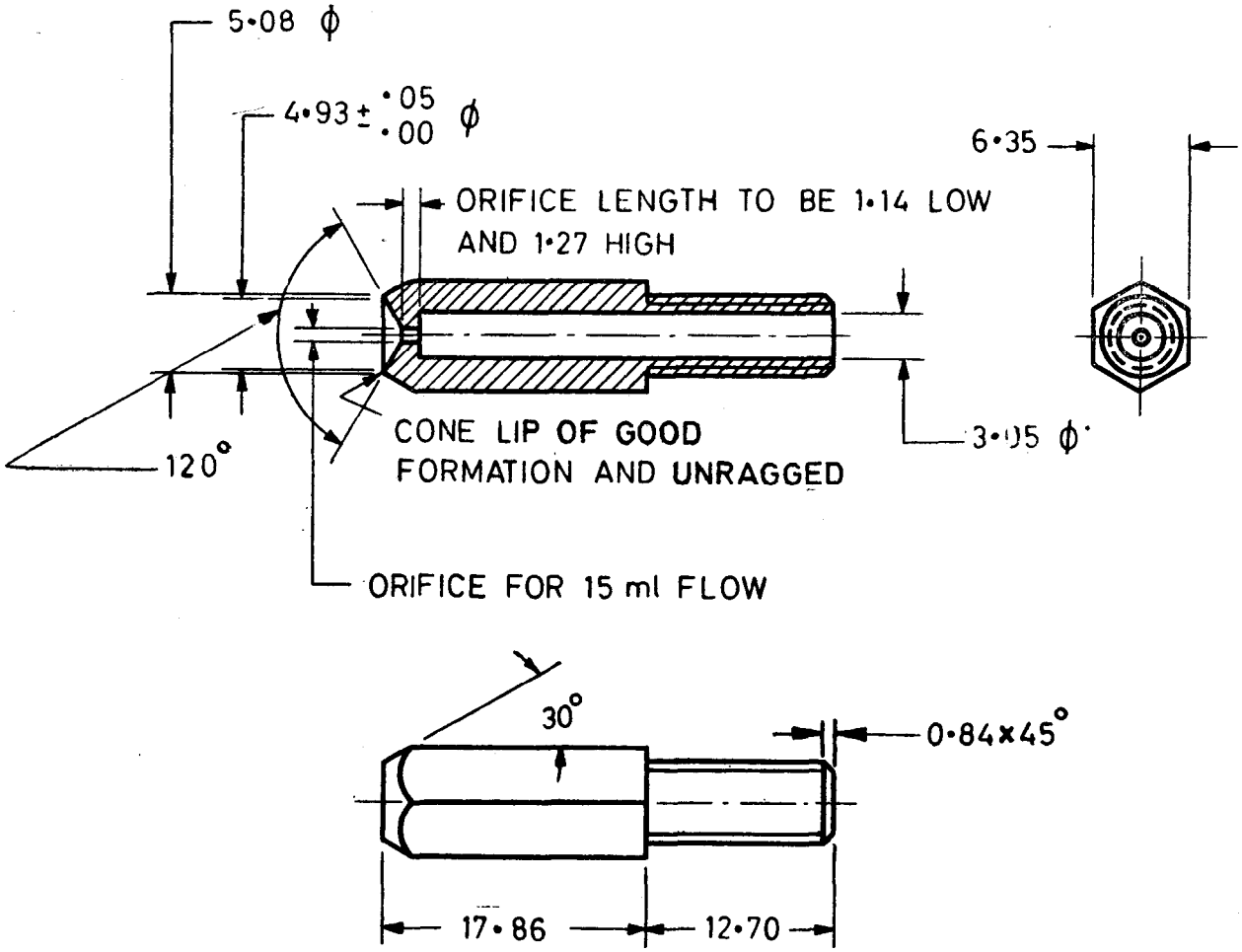


FIG. 1 THE BUNDESMANN TESTER



All dimensions in millimetres.

FIG. 2 JET FOR THE BUNDESMANN TESTER — WATER REPELLENCY TESTING APPARATUS

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